



School of Engineering

EE562: Random Processes in Engineering

Units: 4
Spring 2020

Lecture: Mon. Wed., 12:00-1:50 PM, OHE 132

Discussion: Tue., 3:30-4:20, OHE 136

Instructor: Ashutosh Nayyar

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Office Hours: Mon., Wed. 3:15-4:30PM

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Office: TBD

Office Hours: TBD

Contact Info: TBD

Course Webpage: USC DEN

(<https://courses.uscden.net>)

Exam Dates:

- **Midterm:** March 11 (tentatively), in class
- **Final Exam:** Fri, May 8, 11am-1pm, as set by the university

Course Description

This course provides a rigorous introduction to probability and stochastic process theory and is geared towards first and second year graduate students in electrical engineering, computer science, industrial and systems engineering and other departments. The course will include a review of basic concepts of probability theory including probability spaces, random variables, expectation, and related convergence concepts. It will also cover Gaussian random vectors, minimum mean square estimation and conditional expectation. It will then introduce stochastic processes and key limit theorems. Other topics to be covered include stationary and wide sense stationary processes, correlation and covariance functions, power spectral density, Poisson processes, discrete and continuous-time Markov chains, martingales, basic calculus of random processes, random processes in linear systems and Wiener filtering. The course will provide examples of applications in queueing networks, communications and autonomous systems.

Learning Objectives

1. Introduction to basic concepts, definitions and limit theorems about stochastic processes.
2. Exploring key properties and applications of various kinds of stochastic processes in engineering including communications, networks and autonomous systems.

Prerequisite(s): EE 503 (Probability)

Grading Type: Letter grade

Syllabus, homeworks and other class information will be posted on USC DEN course website.

Required textbook: 1. Random Processes for Engineers by B. Hajek, 2015.

Additional recommended text:

1. Stochastic Processes, 2nd ed. by Sheldon Ross, 1996.
2. Essentials of Stochastic Processes, by Rick Durrett, 2011 (available online).

Grading Breakdown: Final 45%, Midterm 35%, Homework 20%.

Assignment Submission Policy

Late homeworks will not be accepted unless prior approval for late submission has been obtained.

List of Topics to be covered:

1. Probability Review: Random variables, expected value, moment generating functions, conditional distribution, conditional expectation.
2. Sequences of Random variables, modes of convergence and limit theorems.
3. Random vectors, orthogonality principle, minimum mean square estimation.
4. Random processes: Definitions and basic properties.
5. Counting processes, Poisson process, renewal processes.
6. Discrete and continuous time Markov chains.
7. Martingales: Definitions, properties and inequalities.
8. Basic Calculus of random processes, continuity, mean square differentiation, integration.

9. Random processes in linear systems, spectral analysis, Fourier transforms, power spectral density.
10. Wiener Filtering, causal functions and spectral factorization, causal Wiener filtering problem.

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section 11, *Behavior Violating University Standards*<https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct/>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu/> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu/> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.